

96 with one of said ozone water and said hydrogen water.

---

### REMARKS

Favorable consideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 1-23 are presently pending in this application, Claims 2 and 21-23 having been withdrawn from further consideration by the Examiner, Claims 1, 3, 8, 9, 15, 19 and 20 having been amended by the present amendment.

In the outstanding Office Action, the specification was objected to for informalities; Claims 3, 8, 9, 13, 19 and 20 were rejected under 35 U.S.C. §112, second paragraph, for being indefinite; Claims 1, 3-7, 9, 10 12, and 20 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yeol et al. (U.S. Patent 5,983,909) in view of *Handbook of Semiconductor Wafer Cleaning Technology 1993* (hereinafter "Handbook"); Claims 15 and 16 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yeol et al. in view of Handbook; and Claims 17 and 18 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yeol et al. in view of Handbook, JP 63-271938 (hereinafter "JP'938") and Sakai et al. (U.S. Patent 4,812,201).

In response to the objection to the specification, the noted informalities have been corrected herein.

With regard to the rejection under 35 U.S.C. §112, second paragraph, Claims 3, 8, 9, 15, 19 and 20 have been amended to clarify the subject matter recited therein. Thus, Claims 3, 8, 9, 15, 19 and 20 are believed to be in compliance with the requirements of the statute. If, however, the Examiner disagrees, the Examiner is invited to telephone the undersigned

who will be happy to work in a joint effort to derive mutually satisfactory claim language.

Briefly recapitulating, Claim 1 of the present invention is directed to a substrate treatment process for removing organic matter existing on a substrate, including treating the substrate with ozone water prepared by dissolving an ozone-containing gas in ultrapure water and hydrogen water prepared by dissolving a hydrogen-containing gas in ultrapure water in tandem. By treating the substrate as such, fine particles remaining on the substrate are effectively removed without use of chemicals such as sulfuric acid, ammonia, hydrogen peroxide and organic solvent, thereby significantly avoiding corrosion of component parts arrangements and interconnecting conductive materials.<sup>1</sup>

7  
/ Yeol et al. disclose a cleaning method. Nevertheless, Yeol et al. do not teach “treating said substrate with ozone water prepared by dissolving an ozone-containing gas in ultrapure water and hydrogen water prepared by dissolving a hydrogen-containing gas in ultrapure water in tandem” as recited in amended Claim 1. On the other hand, Yeol et al. simply disclose a cleaning method in which a subject is washed with any one of an aqueous oxidizing acidic solution, aqueous oxidizing alkaline solution, an aqueous reducing acidic solution and an aqueous reducing alkaline solution. Specifically, Yeol et al. state as follows:

“...a cleaning method of the present invention comprises: a step for selectively producing ozone water or hydrogen water by dissolving ozone gas or hydrogen gas, respectively, in pure water; a step for producing an aqueous oxidizing acidic or alkaline cleaning solution by selectively mixing an acidic or alkaline solution with ozone water, or selectively producing an aqueous reducing acidic or alkaline cleaning solution by selectively mixing an acidic or alkaline solution with hydrogen water; and a step for washing a subject with any one of the above four types of cleaning solutions.”<sup>2</sup>

---

<sup>1</sup> See, for example, specification, page 8, lines 4-19.

<sup>2</sup> Yeol et al., column 3, lines 5-15.

That is, Yeol et al. only disclose using ozone water and hydrogen water in preparing these types of cleaning solutions. Therefore, the subject matter recited in amended Claim 1 is believed to be clearly distinguishable from Yeol et al.

Likewise, neither Handbook nor JP '938 teaches “treating said substrate with ozone water prepared by dissolving an ozone-containing gas in ultrapure water and hydrogen water prepared by dissolving a hydrogen-containing gas in ultrapure water in tandem” as recited in amended Claim 1. Handbook discloses chemical solutions typically used for cleaning wafers. As an example, Handbook discloses the RCA solutions, *aqueous mixtures* of unstabilized hydrogen peroxide with ammonia and hydrochloric acid. According to Handbook, the “original RCA clean consisted of two cleaning solutions,” SC-1 and SC-2, *were mixed* typically in the ratio of 1:1:5. JP '938 simply discloses irradiating UV light on the surface of a subject to be washed prior to the treatment of a cleaning fluid. Thus, the subject matter recited in amended Claim 1 is clearly distinguishable from both Handbook and JP '938.

Because none of Yeol et al., Handbook, JP '938 discloses the treating step as recited in Claim 1, even the combined teachings of these applied references are not believed to render the subject matter recited in Claim 1 obvious.

For the foregoing reasons, Claim 1 is believed to be allowable. Furthermore, since Claims 2-20 ultimately depend from Claim 1, substantially the same arguments set forth above also apply to these dependent claims. Hence, Claims 2-20 are believed to be allowable as well.

In view of the amendments and discussions presented above, Applicants respectfully submit that the present application is in condition for allowance, and an early action favorable to that effect is earnestly solicited.

Finally, the attention of the Patent Office is directed to the change of address of Applicants' representative, effective January 6, 2003:

Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

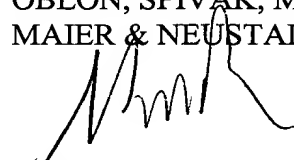
1940 Duke Street

Alexandria, VA 22314.

Please direct all future communications to this new address.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,  
MAIER & NEUSTADT, P.C.



Gregory J. Maier  
Registration No. 25,599  
Robert T. Pous  
Registration No. 29,099  
Attorneys of Record



**22850**

Tel: (703) 413-3000

Fax: (703) 413-2220

GJM/RTP/AY:fmw

I:\ATTY\AKY\20s\201180\ame.wpd

**Marked-Up Copy**

Serial No: 09/742,423

Amendment Filed on:

3-20-03

**IN THE SPECIFICATION**

Please replace two paragraphs at page 2, line 23, through page 4, line 17, with the following text:

--As illustrative conventional techniques for such treatment of substrates, [JP 10-298585 A] JP 10-298589 A discloses a process in which subsequent to plasma ashing of a resist, organic matter and the like on a substrate are removed using ozone water with a basic fluoride added therein. A process is proposed in JP 9-255998 A, in which ultraviolet rays are irradiated in the presence of ozone gas to remove fine organic particles which are remaining on a substrate. JP 10-41262 A discloses to use carbonated water or hydrogen water, which has been prepared by dissolving hydrogen gas in ultrapure water, for the removal of fine metal particles while minimizing corrosion of a pattern such as metalization[.], i.e., a deposited film pattern of a conductor material. Further, it is proposed in JP 10-128253 A to clean and rinse a substrate under exposure to supersonic waves in hydrogen water which has been prepared by dissolving hydrogen gas to a concentration of 0.05 ppm or higher in ultrapure water.

The cleaning with ozone water subsequent to ashing as disclosed in [JP 10-298585 A] JP 10-298589 A involves a potential problem in that a substrate may be damaged as the plasma ashing is performed with high energy, and the cleaning treatment with the ozone water is accompanied by a further potential problem in that the damage may be deteriorated. In addition, surface roughening may also occur by a cause other than the plasma ashing, and the cleaning with the ozone water has a potential problem in that damage may be spread from

such surface roughening. The process disclosed in JP 9-255998 A, in which ultraviolet rays are irradiated in the presence of ozone, is intended for fine organic particles, and cannot be applied for stripping a resist. The cleaning with ozone water, which is disclosed in JP 10-41262 A, is intended to remove fine metal particles, and the effect of the ozone water depends upon the concentration of ozone contained in the ozone water. The concentration of ozone in conventional ozone water, which is available at room temperature under the surrounding atmospheric pressure, is its saturated concentration at the maximum, and therefore, this cleaning process is not considered to be effective for the removal of organic matter still remaining after dry ashing of a resist. Further, the process disclosed in JP 10-128253 A, in which a substrate is soaked in hydrogen water prepared by dissolving hydrogen gas to a concentration of 0.05 ppm or higher in ultrapure water and is exposed to ultrasonic waves, relates to rinsing treatment, and this patent publication makes no mention about the removal of a residue of a resist after dry ashing of the resist.--

### IN THE CLAIMS

Please amend Claims 1, 3, 8, 9, 15, 19 and 20 as follows:

--1. (Amended) A substrate treatment process for removing organic matter existing on a substrate, [which comprises the following consecutive steps:] comprising treating said substrate with ozone water [which has been] prepared by dissolving an ozone-containing gas in ultrapure water[;] and [treating said substrate with] hydrogen water [which has been] prepared by dissolving a hydrogen-containing gas in ultrapure water in tandem.

3. (Amended) A substrate treatment process according to claim 1 or 2, wherein said substrate to be treated is one of a glass substrate [or] and a substrate [formed] comprising one of [crystals of] silicon crystal and [or a] metal compound crystal.

8. (Amended) A substrate treatment process according to claim 1 [or 2], wherein said ozone water [or said ozone-hydrogen water] is applied to said substrate under treatment at a rate not lower than 1 mL/min per square centimeter of substrate area.

9. (Amended) A substrate treatment process according to claim 1 [or 2], wherein said hydrogen water [or said ozone-hydrogen water] is applied to said substrate under treatment after activating said hydrogen water [or said ozone-hydrogen water] by ultrasonic treatment.

15. (Amended) A substrate treatment process according to claim 1[ or 2], wherein said organic matter is subjected to ashing with an oxidizing gas before the step in which the substrate is treated with one of said ozone water[,], and said hydrogen water [or said ozone-hydrogen water].

19. (Amended) A substrate treatment process according to claim 1[ or 2], wherein said substrate is cleaned with an organic solvent before the step in which the substrate is treated with one of said ozone water[,], and said hydrogen water [or said ozone-hydrogen water].

20. (Amended) A substrate treatment process according to claim 1[ or 2], wherein said substrate is treated with HF-containing water after the step in which the substrate is treated with one of said ozone water[,], and said hydrogen water [or said ozone-hydrogen water].--